ESME Workbench Enhancements

David C. Mountain, Ph.D.
Department of Biomedical Engineering
Boston University
44 Cummington St.
Boston, MA 02215
phone: (617) 353-4343 fax: (617) 353-6766 email: dcm@bu.edu

Award Numbers: N000140910487 / N0001411C0448
http://www.bu.edu/hrc/research/laboratories/auditory-biophysics/

LONG-TERM GOALS

The goal of this project is to enhance the flexibility and computational efficiency of the ESME Workbench and to work with NUWC-Newport to merge the NAEMO and ESME approaches into the "One Navy Model". The One Navy Model is intended to serve as the standard simulation system for use in predicting impacts of anthropogenic sound sources on marine life for environmental compliance purposes.

OBJECTIVES

Two versions of the One Navy Model will be created. The first version will designed for use by the US Navy and its subcontractors (classified version) and the second version will have equivalent functionality but will not use data or software codes that are classified or otherwise not available to the general public (unclassified version). After acceptance by NUWC, the features and algorithms in these software packages will remain unchanged during the current permitting cycle for US Navy training exercises while a third version of the simulation software (research version) will continue to evolve.

APPROACH

This proposal builds on the ongoing development of the ESME Workbench and is focused on redesigning and enhancing our existing code base to meet current Navy needs for simulating the impact of sound on marine animals. The software is designed to fulfill the requirements set out in the document *Marine Species Modeling Team Requirements for the Marine Acoustic Effects Simulator Version* 2 (8 August 2010).

The ESME Workbench is organized as a group major of software subsystems. Figure 1 illustrates the conceptual model that is being used to design the ESME system.

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
30 SEP 2011		**00-00-2011 to 00-00-2011**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
ESME Workbench Enhancements	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Boston University,Department of Biomedical Engineering,44 Cummington St,Boston,MA,02215**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**Same as Report (SAR)**	**4**	

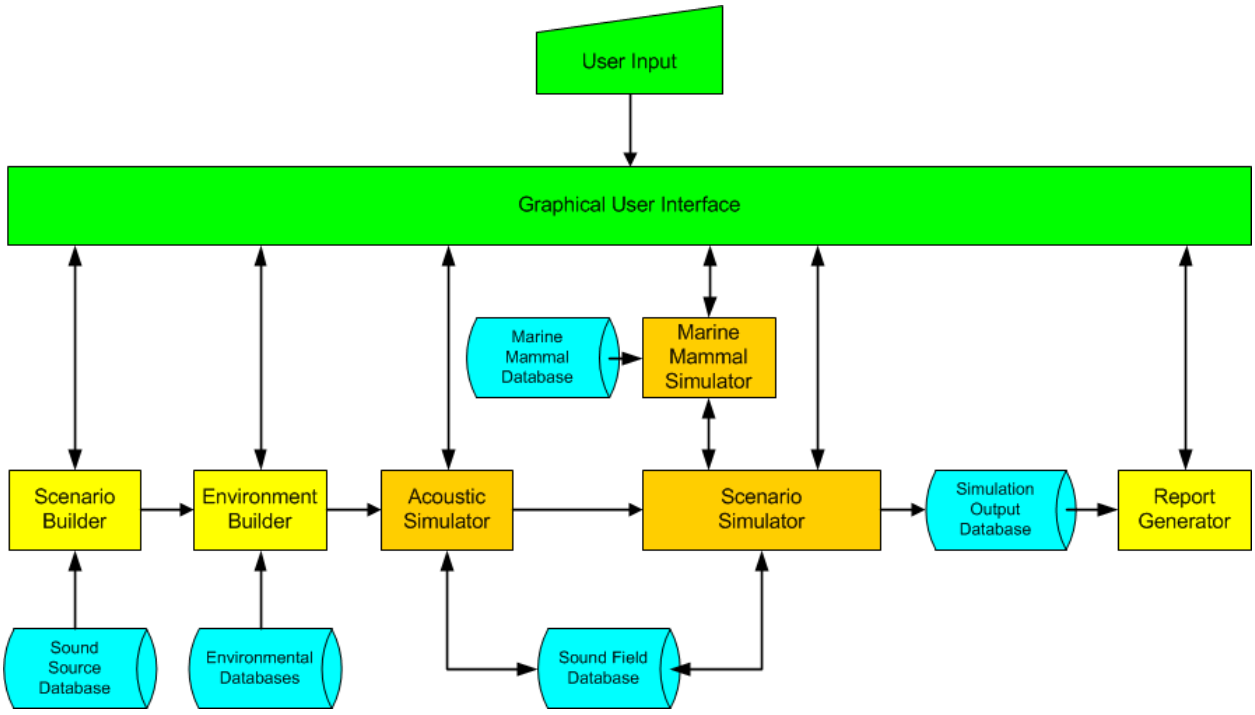

Figure 1. ESME Workbench conceptual block diagram

The Scenario Builder provides the user with a GUI for choosing platforms, attaching sound sources and defining behaviors and number of Monte Carlo runs. The Scenario Builder module is based on the Scenario Builder code that has been developed by NUWC. The Environment Builder provides the user with the ability to import environmental data. These data include bathymetry, sound-speed profiles, bottom type, and wind speed data. For the Classified Model, these data will all be obtained from standard OAML databases. This will also be the case for much of the data used in the Unclassified Model. Data which are not publically available will be replaced in the Unclassified Model with suitable publically available equivalents.

The Acoustic Simulator precomputes sound fields for fixed source locations for use by Scenario Simulator. For mid-frequency and high-frequency sound sources, CASS will be the propagation algorithm used for the Classified Model and Bellhop for the Unclassified Model. For low-frequency sources RAM will be used for the Classified Model and RAMgeo will be used for the Unclassified Model. For explosives REFMS will be used for the Classified Model and codes being developed by Heat, Light, and Sound Research will be used for the unclassified model.

The marine mammal simulator uses animal density estimates to determine the initial starting locations for the simulated marine mammals. For simulations where the animals are moving in three dimensions, the simulator also provides the Scenario Simulator with updated animal positions for each time step.

The Scenario Simulator steps the simulation through time while sound sources and receivers move around and received levels are calculated. All source and receiver locations and received sound levels saved in a database. The Scenario Simulator performs multiple Monte Carlo runs if needed. The simulator is based on the Scenario Simulator developed by NUWC. The Report Generator creates text

files with standardized summary statistics for use in preparing environmental compliance documents and research reports. The Report Generator module was provided by NUWC.

WORK COMPLETED

All the components except the distribution of animats have been integrted into the work bench along with the new user interface.

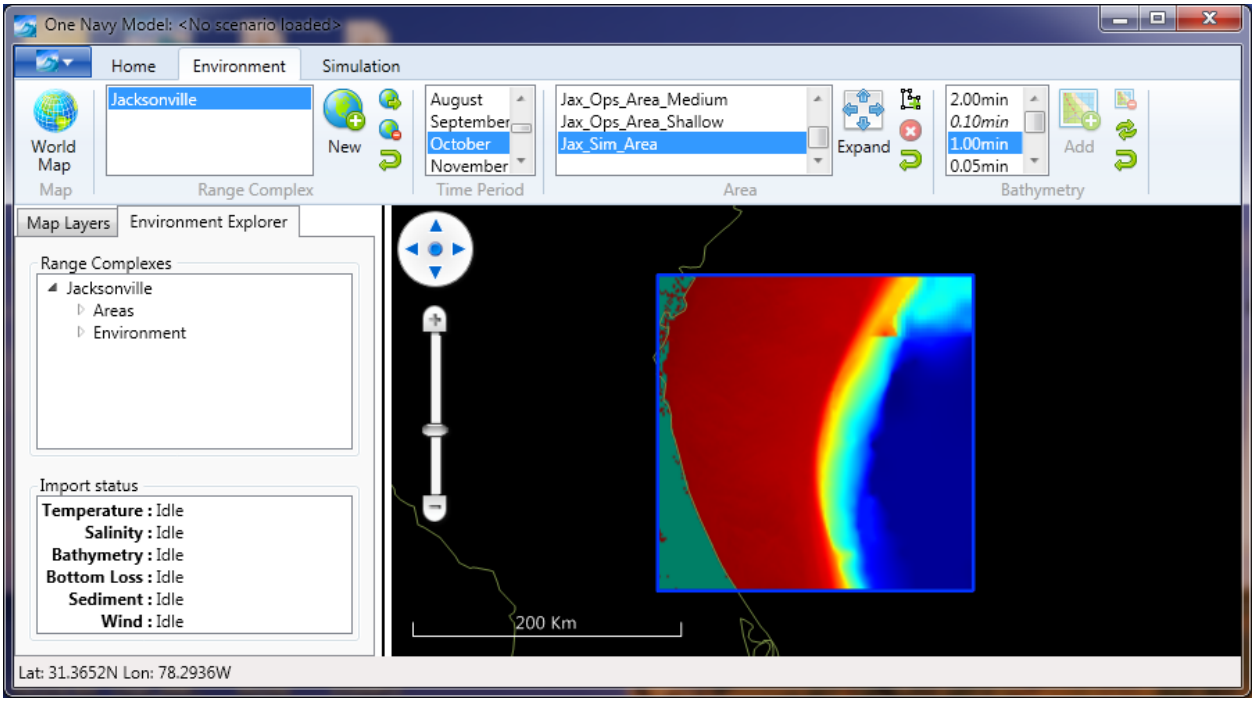

Figure 2: The One Navy Model user interface

The new user interface has been implemented using the "ribbon bar" approach that is designed to have a look and feel that will be familiar to users of Microsoft Windows. Figure 2 shows a sceen shot of the user interface taken after environmental parameters were chosen. Color is used to indicate depth for the bathymetry data layer.

RESULTS

The redesigned simulator can now be used to do end-to-end simulations starting with the specification of a scenario (sound sources, ship tracks, etc.) and ending with summary statistics by species of the number of animals exposed to different sound levels. The system performance has been significantly improved through the use of new methods of optimizing the use of multi-core processors. The system has also been redesigned for "wholesale" simulations where a team of users need to run hundreds of simulations.

IMPACT/APPLICATIONS

The new version of the simulator has been designed with a focus on providing the Navy with a tool for predicting the impact of naval training exercises on marine animals for environmental compliance purposes. The simulator, however, is very modular and with minor changes can be used for a variety of other purposes where the received level or waveform needs to be estimated for any sound source in a marine environment.

RELATED PROJECTS

Principal Investigator	Award Number	File Name
Dorian Houser	N0001407C0793	MBhouse1
Martin Siderius	N000140910485	MBsider1
Martin Siderius	N000141110408	MBsider2